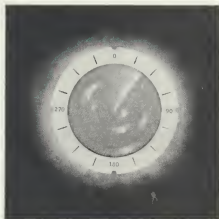


PM SERIES METAL PANELESCENT® LAMPS



Radar Azimuth Scale



Clock Dial



Tractor Panel

GENERAL

Sylvania Panelescent® lamps produce light from an area source through the action of electroluminescence.

Light is generated by excitation of special phosphors, dispersed between two conductive plates, by an alternating electric field. The electrical action is identical to that of a conventional capacitor except that one of the plates, between which an alternating voltage is applied, is transparent to allow the light to be usefully transmitted.

Panelescent lamps provide a uniform, low power, rugged, and highly adaptable light source.

CONSTRUCTION

A Panelescent lamp consists of a base metal plate to which a series of selected coatings is applied to attain a configuration such as shown in figure 1.

The manufacturing process consists of first applying and firing a ceramic coating to the base metal plate followed by another ceramic coating in which are suspended the electroluminescent phosphors. A third coating is applied which is transparent yet electrically conductive. Finally, a transparent finish coating or glaze is applied. Electrical connections to the Panelescent lamps are made to the base plate and the transparent conducting layer which together form the "light" capacitor.

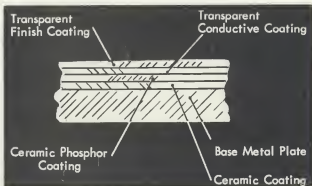


Fig. 1. Cross Section of Panelescent Lamp.

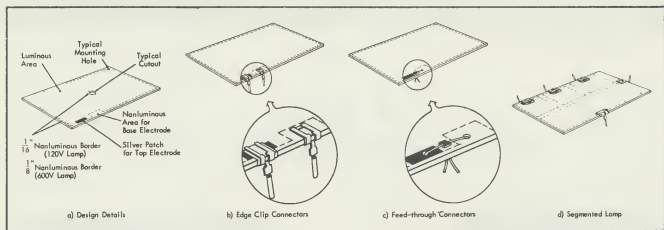


Fig. 2. Ponelescent lamp Design Details and Methods of Electrical Connections.

SIZE AND SHAPE

Theoretically, electroluminescent lamps can be made in any size and shape. In practice, however, it is desirable to work with flat or near-flat surfaces. Current production offers sizes up to 2 feet by 4 feet. The thickness of the lamp is less than 50/1000 inch.

All designs must allow a nonluminous area around the edge of the lamp as well as around any openings as shown in figure 2a. A nonluminous area is also needed for the attachment of electrical contacts.

OPTICAL

Color: Ponelescent[®] lamps are available in a variety of colors obtained by the use of various phosphors and overlays. Table 1 shows the surface brightness of lamps of several colors under three typical phases of operation.

Figure 3 shows spectral energy distribution curves for four colors of Ponelescent lamps. Each curve is plotted relative to its own maximum value. It will be noted that these curves indicate a smooth spectrum. Unlike fluorescent or mercury lamps, there are no "mercury" lines.

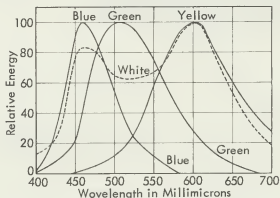


Fig. 3. Spectral Energy Distribution of Ponelescent Lamps

Color	Surface Brightness in Footlamberts		
	120V, 60~	200V, 250~	600V, 60~
Green	1.0	5.0	6.0
Yellow	0.4	2.0	2.4
Blue	0.75	3.75	4.5
White	0.4	2.0	2.4
Red	0.25	1.25	1.5

Table 1. Typical Surface Brightness Values of Ponelescent lamps.

By proper choice of phosphors and overlays, a variety of daylight and luminous colors are available.

Brightness: The surface brightness of an electroluminescent lamp depends upon both applied voltage and frequency.

Figure 4 shows typical relationship of brightness and applied voltage at 60 cps and 400 cps for both a 120 volt and a 600 volt lamp. These curves suggest a simple method of brightness control through variable voltage input.

While it is optically inefficient to operate a high-voltage lamp substantially under-voltage (as a 600V lamp at 120V) because of the unneeded dielectric thickness, no lamp should be operated at higher than its design voltage.

Lamp brightness also increases with frequency, but life decreases. A range of frequencies from 25 to 1000 cps is suitable but an upper limit of 400 cps is considered most practical.

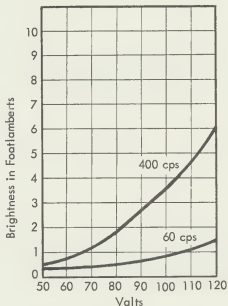


Fig. 4a. Brightness vs Lamp Voltage
120V Green Panelescent Lamp.

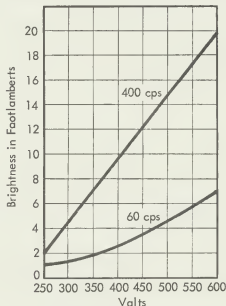


Fig. 4b. Brightness vs Lamp Voltage
600V Green Panelescent Lamp.

Volts	Frequency (CPS)	Current (ma/in. ²)	Impedance (ka/in. ²)	Phase Angle (Degrees)
120	60	0.1	350	60
	400	0.3	360	60
200	250	0.4	700	65
300	60	0.3	1250	60
600	60	0.3	1800	60
	400	0.9	350	50

Table 2. Typical Electrical Characteristics of
Panelescent Lamps.

ELECTRICAL

An electroluminescent lamp not only resembles an electrical capacitor physically but electrically. Circuit-wise it appears as a capacitor and resistor in parallel resulting in a leading power factor of from 0.40 to 0.80. Complete electrical characteristics are shown in table 2.

Electrical connections to a Panelescent[®] lamp are made to the two plates -- the base metal plate and the transparent conductive layer. An applied silver patch is the contact surface for the latter connection.

Either edge clips or feed-through connectors are used for the actual electrical connections as shown in figures 2b and 2c. If desired, a single edge clip or feed-through connector may be used for the top electrode connection and a pressure contact on the back of the base plate completes the circuit. If a completely flat lighted surface is needed, the base plate may be formed with a recess to accommodate the top connection.

Panelcent[®] lamps are available with or without connectors or lead wires. In certain UL-approved applications, suitable resistors can be furnished in the leads as required

MAINTENANCE AND LIFE

Figure 5 shows typical life characteristics of a 120-volt green Panelcent lamp operated at 60 cps. Since the end of life is seldom abrupt, lamp life is generally considered to be the point where brightness reaches 50% of its initial value. If the lamp is used in low ambient light, the useful end of life will be at a much lower brightness level.

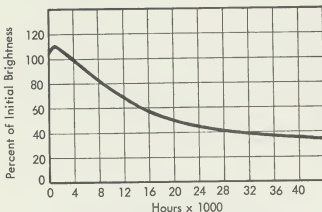


Fig. 5. Lumen Output vs Hours of Operation
120V Green Panelcent Lamp at 60 cps.

TEMPERATURE

An electroluminescent lamp is not greatly affected by ambient temperature. Figure 6 shows lamp brightness over an extreme range of -100°F to $+160^{\circ}\text{F}$.

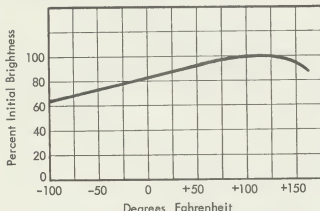


Fig. 6. Lamp Brightness vs Ambient Temperature
120V Green Panelcent Lamp at 60 cps.

DESIGN CONSIDERATIONS

Panelcent lamps are extremely versatile and rugged and lend themselves readily to custom designs.

If cost is a prime consideration the following design features should be minimized as far as practical:

1. Irregular surfaces or edges.
2. Cutouts and holes.
3. Close dimensional tolerances.

In a specific application the following information should be furnished.

1. Operating voltage and frequency.
2. Color.
3. Dimensions and tolerances.
4. Type of electrical connections.

Panelcent lamps must allow a nonluminous border around the periphery of the lamp as well as around all cutouts and holes as shown in figure 2a. In the area of the electrical connections a $1/4$ inch nonluminous area is also required.

Figure 2d shows the design of a segmented lamp with each section separately controlled.

APPLICATIONS

The major uses of Panelcent lamps lie in the illumination of small components such as switch plates, clock dials and other instrument faces under subdued ambient light.

The following are a few of the many applications:

- Clock Dials
- Auto Instrument Panels
- Night Lights
- Tractor Instrument Panels
- Radio and TV Dials
- Radar Consoles
- Decorative Lighting
- Aircraft Instrument Panels
- Photo-transparency Lighting
- Signs

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